

AMENDMENTS TO CLAIMS

1. (Currently Amended) A method ~~of for~~ producing a hologram from a virtual object (6) defined in a three-dimensional geometrical space (O, x, y, z) ~~characterized in that it includes~~ said method comprising the ~~following steps of:~~

computing (E1-E4) a set of two-dimensional images (80_{nm}) representing the object as seen from respective different viewpoints in the three-dimensional geometrical space, each of said two-dimensional images (80_{nm}) representing the object as seen from one of said different viewpoints,

computing (E5-E6) a set of elementary holograms (90_{nm}), each of said elementary holograms respectively corresponding to one of said two-dimensional images, and

combining (E7) said elementary holograms (90_{nm}) in a common digital image to form a hologram (9) of the object (6).

2. (Currently Amended) A method according to claim 1, wherein said step of computing the set of two-dimensional images includes the following steps:

defining a first geometrical plane (7) in the three-dimensional geometrical space, said first geometrical plane being separate from said object,

defining (E1-E2) in the three-dimensional space a matrix of points (70_{nm}) in ~~a~~ said first geometrical plane (7) separate from the object (6), each of said points corresponding to one of said different viewpoints,

defining a second geometrical plane (8), said second geometrical plane (8) being parallel to said first geometrical plane and preferably located between the object (6) and the first geometrical plane (7), and

projecting (E3-E4) images of the object as respectively seen from said points (70_{nm}) of said matrix onto ~~a~~ said second geometrical plane (8) which is preferably between the object (6) and the first plane (7) and parallel to the first plane, wherein the project projected images constituting constitute said two-dimensional images (80_{nm}).

3. (Original) A method according to claim 2, wherein, for each point (70_{nm}) of the matrix, said projection step consists of projecting points (60) of the object (6) onto the second plane (8) along respective straight lines passing through said points of the object and said each point of the matrix.

4. (Previously Presented) A method according to claim 1, wherein said step (E5-E6) of computing the holograms is implemented using a technique employing a Fourier transform.

5. (Currently Amended) A method according to claim 1, wherein said two-dimensional images (80_{nm}) are defined by respective real functions (f_{nm}(Y,Z)) and said step (E5-E6) of computing the holograms comprises the following steps for a given two-dimensional image (80_{nm}):

transforming (E50, E51) the given two-dimensional image defined by the corresponding real function into a complex two-dimensional image defined by a complex function,

oversampling (E52) the complex image (82_{nm}),

simulating (E53) the production of a diffracted image, said diffracted image corresponding to resulting from the diffraction of an optical wave (DIF) by the oversampled complex image (83_{nm}),

adding (E54) a complex field representing a reference optical wave (REF) to the resulting diffracting diffracted image (84_{nm}), and

encoding (E6) values taken by the amplitude of the sum of said complex field and the resulting diffracted image (84_{nm}) to produce the hologram (90_{nm}) associated with said given two-dimensional image (80_{nm}).

6. (Currently Amended) A method according to claim 5, wherein said transform step includes the following steps:

determining (E50) amplitude values of the complex two-dimensional image, said amplitude value each depending on the square root of a corresponding intensity value taken by said real function of the given two-dimensional image defined by said real function, and

associating (E51) a phase with each of said amplitude values so that an amplitude value and a phase value are defined for each point of the complex image.

7. (Previously Presented) A method according to claim 5, wherein said simulation step (E53) includes the computation of at least one of the following complex transforms: Fourier transform, Walsh transform, Hankel transform, orthogonal polynomial transform, Hadamar transform, Karhunen-Loeve transform, multiresolution discrete wavelet transform, adaptive wavelet transform and a transform consisting of a composite of at least two of the above transforms.

8. (Original) A method according to claim 7, wherein said simulation step (E53) consists of computing a convolutional product, associated with the oversampled complex image, of two components, by applying the transform which is the inverse of said complex transform to the product of the respective complex transforms of said two components.

9. (Currently Amended) A method according to claim 1, wherein said step (E7) of combining the holograms comprises juxtaposing the holograms (90_{nm}) of the two-dimensional images (80_{nm}) in a said common digital image (9) constituting said hologram (9) of the object (6).

10. (Currently Amended) A method of producing a three-dimensional image from a virtual object (6) defined in a three-dimensional geometrical space (O, x, y, z), characterized in that it includes comprising the following steps:

producing a hologram (9) of the object (6) by the a method according to one of claims 1 to 9,

physically reproducing (E8) said hologram (9) of the object (6) on a spatial light modulator (2), and

illuminating (E8) the spatial light modulator (2) in order to reproduce a three-dimensional image of the object (6) from the hologram (9).

11. (Original) A method according to claim 10, wherein said spatial light modulator (2) comprises a liquid crystal screen having a pixel pitch less than 10 μm and preferably from 1 μm to 2 μm in at least two different directions.

12. (Currently Amended) A method according to claim 10, wherein the step of illuminating the spatial light modulator (2) consists of illuminating ~~it~~ said spatial light modulator with three optical waves (4a, 4b, 4c) respectively representing the colors red, green and blue (RGB) in turn and in synchronism with reproduction by the spatial light modulator (2) of a sequence of holograms of the object, ~~produced by a method according to any one of claims 1 to 9 and each~~ hologram corresponding to one of the said three colors, so that a three-dimensional color image of the object (6) is reproduced.

13. (Currently Amended) A method according to claim 10, wherein a sequence of holograms is physically reproduced by the spatial light modulator (2) ~~and each of the holograms of the sequence is produced by a method according to any one of the claims 1 to 9~~, so that after the step of illuminating the spatial light modulator animated three-dimensional images of the object (6) are reproduced.

14. (Currently Amended) A system for producing a hologram from a virtual object (6) defined in a three-dimensional geometrical space (O, x, y, z), characterized in that it includes comprising:

memory means (1) for storing ~~in~~ memory the virtual object (6) defined in the three-dimensional geometrical space (O, x, y, z),

first computing means (1) for producing a set of two-dimensional images (80_{nm}) representing the object (6) as seen from respective different viewpoints in the three-dimensional geometrical space, each of said two-dimensional images (80_{nm}) representing the object as seen from one of said different viewpoints;

second computing means (1) for producing elementary holograms (90_{nm}), each of said elementary holograms respectively corresponding to one of said two-dimensional images (80_{nm}), and

combining means (1) for combining said elementary holograms (90_{nm}) in a common digital image to form a hologram (9) of the object (6).

15. (Currently Amended) A system according to claim 14, wherein said first computing means comprise projection computing means (1) for computing a projection of images of said object (6) as seen from respective points (70_{nm}) of a matrix of points in a first geometrical plane (7) separate from the object (6) onto a second geometrical plane (8) which is preferably between the object (6) and the first plane (7) and parallel to the first plane (7) in the three-dimensional geometrical space (O, x, y, z), wherein each of said points of said matrix of points corresponds to one of said different viewpoints.

16. (Original) The system claimed in claim 15, wherein said projection computing means comprise means (1) for computing, for each point (70_{nm}) of the matrix, the projection of points (60) of the object (6) onto the second plane (8) along respective straight lines passing through said points of the object and said point of the matrix.

17. (Currently Amended) A system according to claim 14, wherein said two-dimensional images (80_{nm}) are defined by respective real functions ($f_{nm}(Y, Z)$) and the second computing means comprise:

transform means (1) for transforming (E50, E51) a given two-dimensional image (80_{nm}) defined by a corresponding real function into a complex image defined by a complex function, means (1) for oversampling (E52) the complex image,

simulator means (1) for simulating (E53) the production of a diffracted image, said diffracted image corresponding to the diffraction of an optical wave (DIF) by the oversampled complex image,

means (1) for adding (E54) a complex field representing a reference optical wave (REF) to the resulting diffracted image (84_{nm}), and

means (1) for encoding (E6) values taken by the amplitude of the sum of said complex field and the diffracted image (84_{nm}) to produce the hologram (90_{nm}) associated with said given two-dimensional image (80_{nm}).

18. (Currently Amended) A system according to claim 17, wherein said transform means comprise:

means (1) for determining (E50) amplitude values, said amplitude values each depending on the square root of a corresponding value taken by said real function, and

means (1) for associating (E51) a phase with each of said amplitude values so that an amplitude value and a phase value are defined for each point of the complex image.

19. (Original) A system according to claim 17 or claim 18, wherein said simulator means comprise means (1) for computing one of the following complex transforms: Fourier transform, Walsh transform, Hankel transform, orthogonal polynomial transform, Hadamar transform, Karhunen-Loeve transform, multiresolution discrete wavelet transform, adaptive wavelet transform and a transform consisting of a composite of at least two of the above transforms.

20. (Original) A system according to claim 19, wherein said simulator means comprise means (1) for computing a convolutional product, associated with the oversampled complex image, of two components, by applying the transform which is the inverse of said complex transform to the product of the respective complex transforms of said two components.

21. (Currently Amended) A system according to claim 14, wherein the combining means (1) comprise means for juxtaposing the holograms (90_{nm}) of the two-dimensional images (80_{nm}) in said common digital image (9) constituting said hologram of the object (6).

22. (Currently Amended) A system for producing a three-dimensional image from a virtual object (6) defined in a three-dimensional geometrical space (O, x, y, z), comprising:

a system according to one of claims 14 to 21 for producing a hologram (9) of the object (6),

a spatial light modulator (2) for physically reproducing the hologram (9) of the object, and

a light source (4) for illuminating the spatial light modulator (2) in order to reproduce a three-dimensional image of the object (6) from the hologram (9).

23. (Original) A system according to claim 22, wherein said spatial light modulator (2) comprises a liquid crystal screen having a pixel pitch less than 10 μm and preferably from 1 μm to 2 μm in at least two different directions.

24. (Currently Amended) A system according to claim 22, wherein said light source comprises three separate light sources (4a, 4b, 4c) for illuminating the spatial light modulator (2) with three optical waves respectively representing the colors red, green, and blue (RGB) in turn and in synchronism with the reproduction by the spatial light modulator (2) of a sequence of holograms of the object, each hologram corresponding to one of said three colors so that a three-dimensional color image of the object is reproduced.

25. (Currently Amended) A system according to claim 22, wherein said system for producing a hologram of said object is on a first site, the spatial light modulator (2) and the light source (4) are on a second site and the first and second sites are remote from each other.